PEPTIDE PHOTONICS: FROM BIOINSPIRED NANODOTS TO BIOMEDICAL NANOTECHNOLOGY

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Bionanophotonics is a wide field where combination of biotechnology, fundamental physics, advanced optical materials and nanotechnology result in development of new biomedical tools towards precise photomedicine.

In this work we present a novel paradigm of biomedical integrated optical systems applying new generation of bioinspired and biocompatible peptide materials, their nanotechnology and patterning. It combines developed bottom-up controlled deposition of planar peptide wafers of a large area and top-down high resolution patterning for fabrication of peptide integrated photonic nanoprobes and biochips.

We demonstrate high optical transparency, effective linear and nonlinear light waveguiding in a wide optical region covering UV-visible and near infrared spectrum. We found that these photophysical properties of nanomaterials of biological origin can be deeply modified by refolding of fundamental biological secondary structure from native α-helical to β-sheet which is followed by appearance of visible fluorescence and transition from native passive optical waveguiding to active fluorescent waveguiding. This new effect is attributed to reconstruction of electronic energy spectrum of intermolecular hydrogen bonds of refolded β-sheets structures. The ability to observe and tune photonic emission wavelength over the whole visible spectrum and achieve optical confinement for efficient waveguiding leads to a new biomedical tools of micro- and nanolasers.

Found new biomedical materials with tunable multifunctional optical properties combining with original biocompatibility make these photonic nanounits attractive for applications in precision photomedicine for biomedical imaging and diagnosis, light-activated therapy, optogenetics and emerging technology of implantable biooptical chips towards health monitoring.

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